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(54) Abstract Title
Transferring configuration data to a software defined radio apparatus

(57) Configuration data is transferred from a data source 110, such as a software download server, to a software defined radio apparatus 130, particularly a mobile telephone, via an intermediate apparatus 120 which has means 126 for storing the data received from source 110 prior to onward transfer to the radio 130. The data may be transferred from server 110 to intermediate apparatus 120 at a time selected by apparatus 120 or by server 110, or at a predetermined time or times set by an overall system control. Alternatively, a request for configuration data may be sent from radio 130 to server 110 via apparatus 120 or via a route not involving apparatus 120. The link 115 between server 110 and intermediate apparatus 120 may be a standard telecommunications link, or may take place via a mains power network which is convenient if the apparatus 120 also includes a mains based battery charger 125. In that case, apparatus 120 can simultaneously charge the battery 131 of the radio and transfer configuration data to radio 130 from store 126 when the radio 130 has been coupled to the apparatus 120 via connectors 127, 137.

The configuration data may be related to operation on one or more vocoding schemes, or to operation of multimedia functions, or to operation on one or more multiple access schemes, such as TDMA, CDMA, GSM, UMTS, AMPS, CDMA 2000, wideband-CDMA, combined TDMA/CDMA, iDEN, EDGE, IS 136, IS 95A/B, TETRA.

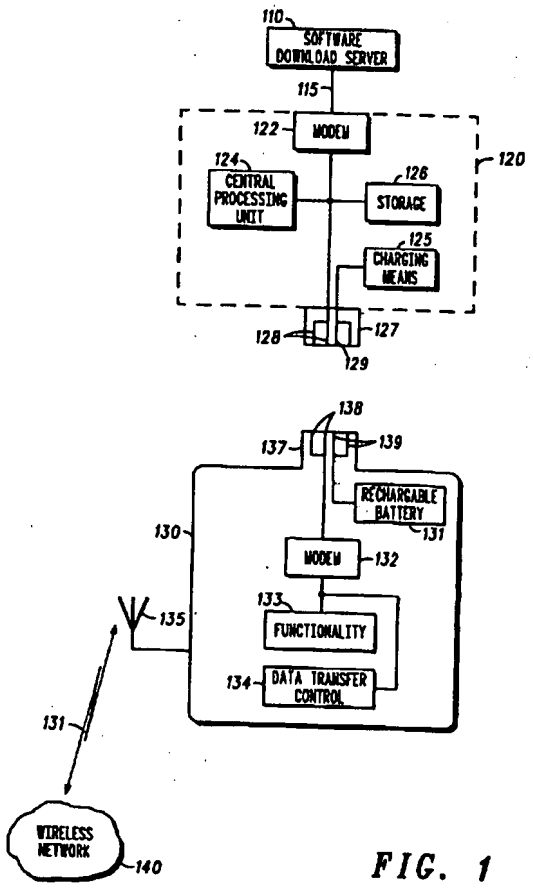

FIG. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

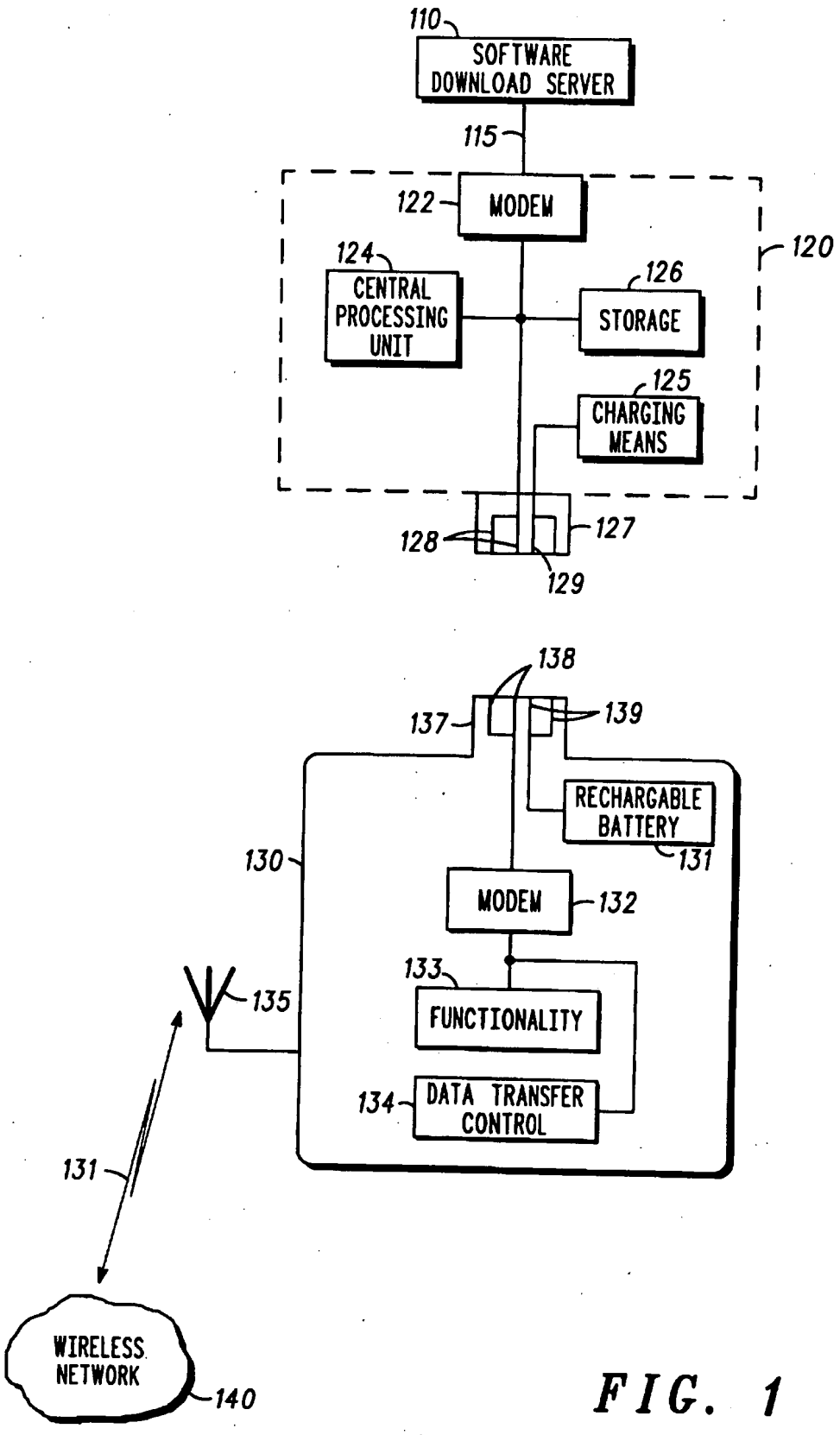
110
SOFTWARE DOWNLOAD SERVER
115
122
MODEM
120
124
CENTRAL PROCESSING UNIT
126
STORAGE
125
CHARGING MEANS
128
127
129
138
137
139
RECHARGABLE BATTERY
131
130
MODEM
132
133
135
FUNCTIONALITY
134
DATA TRANSFER CONTROL
131
WIRELESS NETWORK
140

FIG. 1

TRANSFERRING CONFIGURATION DATA TO A SOFTWARE DEFINED RADIO APPARATUS

Field of the Invention

The present invention relates to the transfer of configuration data to a software defined radio apparatus. The present invention is applicable to, but not limited to, software defined radio whose functionality can be reconfigured with respect to different multiple access schemes such as GSM, UMTS, CDMA2000, and software defined radio that can have its functionality reconfigured with respect to different vocoding schemes or different multi-media functions.

Background of the Invention

Many types of radio communications systems are known. One type is two-way radio, another type is cellular radio communications systems. One well known type of cellular communications system is GSM. The apparatus used by individual users of such systems can be mobile, for example a mobile telephone as used in a GSM cellular system. Traditional radio apparatus has fixed functionality determined by hardware contained in the apparatus. For example a traditional mobile telephone for a GSM system contains the necessary hardware, including programmed memories and processors, for the telephone to operate on the required frequencies, vocoding schemes, and multiple access protocols, and the prescribed time division algorithms, as laid down in the GSM system requirements. Although a user of such a mobile telephone may be able to input preferred selections related to the operation of the telephone, nevertheless such selections only consist of a choice from existing capabilities provided in that telephone. As such, although the user possibly is able to define a choice of functionality, nevertheless all the required elements of such

functionality already are present in the telephone. Indeed a complicated mobile telephone can be envisaged consisting of all the hardware necessary for that telephone to operate on a time division multiple access (TDMA) scheme such as GSM, and also all the hardware necessary for that telephone to alternatively work on a code division multiple access scheme (CDMA). The term hardware is to be understood in the sense of not only electronic components but also the settings pre-programmed into items such as programmable memory, processing units, and so on. In such a telephone there is the possibility to use either type of functionality, that is the first functionality of TDMA or the second functionality of CDMA, however it should be noted that the mobile telephone is configured always to have the means for both functionalities.

In contrast to the previous paragraph, a further known form of radio apparatus is that which is usually called software defined radio. In a software defined radio some degree of the functionality of that radio is provided in a form that can be re-configured by means of providing configuration data/software which when implemented in the radio apparatus provides that apparatus with alternative or additional functionality. Thus contrasting to the above description of a mobile telephone comprising all the hardware for TDMA functionality and CDMA functionality, a software defined radio might initially be configured to operate as a TDMA telephone, but would have circuitry and processing means able to receive configuration data that when assimilated into the telephone provides the telephone with the functionality or the capability to be a CDMA telephone. Different degrees of such configuration data or software forming this process are possible, from small top-ups to the operating hardware of the telephone's original functionality through to completely new arrangements. However, whichever degree is the case, the common point is that functionality is provided to the telephone, in other words, brought into the telephone, that was previously not there before such re-configuration. In this way a software defined radio or software defined radio apparatus can be distinguished from other types of radio apparatus which at most receive instructions relating to a selection between existing capabilities of that apparatus. In other words a software defined radio acquires new or different technical capability with respect to operation in the

newly configured form that it takes after receipt of the configuration data/software that is provided to it.

In the above description of software defined radio the operational functionality that has been used in an exemplary fashion is that of which multiple access scheme is used in a cellular communications system. Many other types of functionality are also capable of being re-configured by software defined radio. Other such examples include changing between different vocoding schemes, or implementing different forms of multi-media capability in communications systems using multi-media, such as UMTS (Universal Mobile Telephone System), which is currently under standardisation.

In order to re-define the configuration of a software defined radio apparatus, it is necessary to transfer or download software containing the required configuration data to the radio apparatus. One known means for downloading or transferring the configuration data consists of transmitting the data to the radio over the normal radio link employed by the radio during its normal communication mode. One disadvantage of this method is that normal communication must be interrupted. Another disadvantage is that problems arise with respect to synchronising the availability of the radio on the radio link along with the provider of the software likewise being ready and aware to transmit such software over the radio link. Further problems arise with respect to the question of the provider of the software having access to the radio link in the first place. Another known means for transferring the configuration data is to do so from one or more smart cards or other modules containing the relevant software that are placed in, or in connection to, the radio apparatus. However this latter method is disadvantageous due to the physical logistics involved in acquiring such cards or modules, and so on.

Summary of the Invention

The present invention provides a means for transferring the configuration data that alleviates the above disadvantages.

According to one aspect of the present invention, there is provided a method of transferring configuration data to a software defined radio apparatus, as claimed in claim 1.

According to another aspect of the present invention, there is provided a software defined radio apparatus as claimed in claim 11.

According to another aspect of the present invention, there is provided an intermediate apparatus for acting as an intermediary in a process of transferring configuration data to a software defined radio apparatus, as claimed in claim 17.

According to another aspect of the present invention, there is provided an arrangement for transferring software defined radio configuration data, as claimed in claim 27.

Further aspects of the invention are as claimed in the dependent claims.

The present invention advantageously provides a method of transferring configuration data that avoids the need for either main radio link or physical module usage. Furthermore, the present invention provides advantages due to the software download process being carried out off-line and at times suitable to either the end user or the provider of the configuration data. The present invention also advantageously allows the software download processes to be continuous, hence avoiding any possible errors introduced by discontinuous download.

A preferred version of the present invention uses an intermediate apparatus that also carries out mains charging of a re-chargeable battery of a software defined radio apparatus. This preferred version provides further advantages due to the ease of operation of having the configuration data downloaded at the same time or by the same means as are employed by the user to carry out routine electrical charging of his apparatus.

Additional specific advantages are apparent from the following description and figures.

Brief Description of the Drawing

FIG.1 is a schematic illustration of an embodiment of the present invention.

Description of an Embodiment of the Invention

One particular embodiment of the invention is now described by way of example only.

The software defined radio apparatus of the present embodiment is shown as item 130 in FIG. 1. In the present example the apparatus is a mobile telephone originally configured to operate on a GSM system, hence a Time Division Multiple Access (TDMA) system. The apparatus 130 includes a re-chargeable battery 131. It also includes circuitry including processing units and programmable memory shown as an overall item called functionality 133 in FIG.1. The original configuration to a GSM system will be implemented in the functionality 133 in any known appropriate form. Also shown in FIG.1 is antenna 135 of the software defined radio apparatus 130, which antenna transmits and receives signals via radio link 136 to a wireless network 140, which in the present embodiment corresponds to a cellular communications system. The software defined radio apparatus 130 also includes the following components which are used when configuration data is received. Modem 132 receives such data and converts it into a form understood by both functionality 133 and a further means shown as data transfer control 134 in FIG.1. Modem 132 is coupled to functionality 133 and also data transfer control 134. Functionality 133 is also coupled to data transfer control 134. In the present embodiment a connector 137 is also present as part of software defined radio apparatus 130. Connector 137 includes connector elements 138 which are

coupled to modem 132 and hence also to functionality 133 and data transfer control 134. In the present embodiment connector 137 also includes connection elements 139 which are coupled to re-chargeable battery 131.

FIG.1 also shows a further apparatus of the present embodiment called intermediate apparatus 120. Intermediate apparatus 120 includes its own modem 122 which is coupled to central processor unit 124 and storage 126. CPU 124 and storage 126 are consequently coupled to each other. Intermediate apparatus 120 also includes, in the present embodiment, charging means 125. The intermediate apparatus 120 also includes, in the present embodiment, connector 127. Connector 127 includes connection elements 128 which are coupled to modem 122, central processor unit 124 and storage 126. Connector 127 also has connection elements 129 which are coupled to charging means 125. In the present embodiment intermediate apparatus 120 is coupled via a communications link 115 to a software download server 110.

In the present embodiment the user of software defined radio apparatus 130 knows in advance that he will require his apparatus to be re-configured to a CDMA communications system some time in the foreseeable future. In the present example re-configuration will be to add the functionality of CDMA to this telephone, although in other cases it could be to replace the present TDMA functionality. Consequently the user would have already advised the operator of software download server 110 of his requirement for the new configuration, hence the re-configuration data, he requires.

Software download server is therefore used to send the required software over communications link 115 to intermediate apparatus 120. In the present example communications link 115 consists of the electrical mains network and intermediate apparatus 120 is programmed to receive the relevant software by having an address identity corresponding to a coded header on the downloaded information. The time at which the download is made is determined by the software download server itself which transmits the information at a time chosen as convenient for its overall work load as defined by the operator of download

server 110. Thus the configuration data is transmitted to intermediate apparatus 120. It is to be appreciated that in other embodiments communications link 115 could consist of a standard telecommunications link and does not necessarily have to be mains network. On the contrary the use of an electrical mains network merely provides particular advantages in the present example where the intermediate apparatus is also a charging means for the software defined radio apparatus, as will be explained more fully later below. The configuration data is received by modem 122 of intermediate apparatus 120 and converted into a suitable format for the intermediate apparatus 120, in particular its central processing unit 124 and its storage 126. Under the control of central processor unit 124 the configuration data is stored in suitable format in storage 126. In the present example storage 126 consists of a programmable electronic memory. Alternative storage means can be employed as required, in known fashion by the skilled person.

In the present embodiment the intermediate apparatus 120 is advantageously both an intermediary apparatus for the transfer of the configuration data and also the charging apparatus for providing electrical charge to re-charge the re-chargeable battery 131 of the software defined radio apparatus 130. Consequently, when the user of apparatus 130 connects the apparatus 130 to the intermediate apparatus 120 for the purpose of re-charging the battery, connection is also made automatically with the configuration data transfer means. Thus in the present example, when the two items are connected via connector 137 of software defined radio apparatus 130 and connector 127 of intermediate apparatus 120, the following connections are made. Connection elements 128 of the intermediate apparatus connect with connection elements 138 of the software defined radio apparatus 130. At the same time connection elements 129 of the intermediate apparatus 120 connect with connection elements 139 of the software defined radio apparatus. Thus in the present embodiment very advantageously all required connections for charging and for configuration data transfer, i.e. two separate activities that conventionally require separate procedures by the user, are implemented together by the user in one simple step in the present embodiment of the invention. It is to be

appreciated however that in simpler embodiments of the present invention that do not involve mains charging, the user nevertheless still achieves significant advantages from the basic configuration data transfer means of the present invention. Similarly, in units involving charging as well as transfer of configuration data, other reasons may lead to the use of separate connectors.

In the present embodiment once connection is made for the purpose of charging, then during the charging procedure the configuration data is transferred to the software defined radio apparatus. In the present example such transfer of configuration data takes place whenever configuration data is ready stored in storage 126 of intermediate apparatus 120. However in other examples it would be possible for such configuration data transfer to only take place when requested by the user by means of a control function on software defined radio apparatus 130 that instructs intermediate apparatus 120 via an appropriate connection element as required. In such cases intermediate apparatus 120 could optionally include indication means for indicating to the user that stored configuration data was available. Yet another alternative would be for intermediate apparatus 120 to instruct software defined radio apparatus 130 to indicate to the user that configuration data was ready in storage of the intermediate apparatus 120, and the user would then indicate or confirm whether such configuration data was to be transferred during the occurring charging connection.

The configuration data is transferred into software defined radio apparatus 130 by being passed into modem 132 of the software defined radio apparatus 130. Data transfer control 134 of the radio apparatus 130 will then control implementation of the downloaded configuration data into the actual functionality circuitry and programming of the apparatus. In some cases the configuration data would be accompanied by instructions that it was required to be installed immediately by data transfer control 134 into functionality 133, in other cases such implementation would be delayed. In the case of delayed implementation, one possibility would be for implementation to take place at a specific future time, another possibility would be for implementation to be carried

out when demanded by the user by means of suitable control means linked to data transfer control 134. Conventional menu choices could be employed for this.

In the above description the configuration data was transferred to the intermediate apparatus at a time selected by the software download server 110. Alternatively, however, such transmission of the configuration data can be performed at a time selected by the intermediate apparatus. For example intermediate apparatus 120 can include communications means for communicating in both directions with software download server 110 along communications link 115, in which case intermediate apparatus 120 can be such as to inform software download server 110 of times when the new configuration data should be transferred, and in this case for example intermediate apparatus 120 would then request transfer of any outstanding configuration data whenever it was turned on. Alternatively, intermediate apparatus 120 may be initiated into requesting the download of the configuration data in response to an instruction put into it by the user of the intermediate apparatus, that user being the same user of the software defined radio apparatus 130. Yet another alternative would be for an overall system control to be in place such that whenever configuration data was required to be transferred from software download server 110 to intermediate apparatus 120, such transmission would occur at a pre-determined time set by the overall system control. For example, this could be at a time originally specified by the user of software defined radio apparatus when communicating his original request to software download server 110. An alternative possibility would be for an overall system control or pre-programmed synchronisation to specify that configuration data would be transferred from the software download server to the intermediate apparatus at repeated pre-determined times, for example once every hour or once every day. This could be carried out for a given period of time, on the assumption that within such a time successful transfer would have occurred, or alternatively could be carried on for each repetition of the set of pre-determined times until a confirmation message was sent from intermediate apparatus 120 to software download server 110.

In the above embodiment the initial request from the software defined radio apparatus for transfer of configuration data from software download server 110 was made by a communications route separate from any such route involving intermediate apparatus 120 and communications link 115. However, in an alternative arrangement, it is possible for such request to be communicated via intermediate apparatus 120 and communications link 115. Such a request could also be made as a type of back up communication to an initial request made via another route. The request transmitted via intermediate apparatus 120 could be sent during the start of a charging electrical charging phase, the request could be received and processed by software download server relatively quickly, and the configuration data then transferred to the intermediate apparatus 120, which then stores the configuration data in storage 126 and then transfers such data to software defined radio apparatus 130 all within the period of which charging is carrying on from charging means125 into re-chargeable battery 131. Such transfer of configuration data could also take place whilst the software defined radio apparatus remains connected to the intermediate apparatus, especially from the point of view of the user, even if charging strictly speaking is in fact complete.

For completion's sake, it is also noted that the basic advantages of the present invention arising from transfer of configuration data via an intermediate apparatus will be preserved even if data transfer takes place at a different time to electrical charging, from apparatus as described above. Furthermore, such an arrangement would still provide the user with convenience of just one apparatus and one connection, even if the two activities did not take place simultaneously each time.

A further variation worthy of mention is the arrangement wherein the user knows which software he requires and informs the intermediate apparatus of this. The server continually broadcasts configuration data, and the intermediate apparatus identifies the required part and downloads it.

In the above example the re-configuration of the mobile telephone consisted of providing CDMA functionality to a mobile telephone that originally only had TDMA functionality. It will be appreciated that in other embodiments examples of multiple access schemes that can be selected or implemented include the following: GSM, UMTS, AMPS, CDMA 2000, wideband-CDMA, combined TDMA/CDMA, iDEN, EDGE, IS 136, IS 95A/B, TETRA.
It will also be appreciated that more than one multiple access scheme can be implemented into functionality 133, either replacing previous access schemes or adding thereto.

Similarly, the configuration data can consist of data related to operating on one or more vocoding schemes. Yet further, the configuration data can comprise data related to operation of one or more multi-media functions, including for example video, text, voice activation, and so on.

Further possibilities exist with respect to the question of requesting the transfer of the configuration data, as explained in the following. In one scenario wireless network 140 makes a call to software defined radio apparatus 130 over radio link 136 signalling a request to participate in a future process. Software defined radio apparatus 130, in the present case a mobile telephone, responds by giving positive confirmation of the user's desire to take part in the future process. When software defined radio apparatus 130 is next connected to intermediate apparatus 120 a request for transfer of the relevant configuration data is transmitted to software download server 110 via intermediate apparatus 120 and already established communications link 115. This request would also involve for example a specification of when the configuration data should be transmitted to intermediate apparatus 120. At the requested time the intermediate apparatus 120 initiates a call to the download server 110 over communications link 115 and the configuration data transfer process is carried out as already described above. Optionally the software defined radio apparatus 130 could call wireless network 140 over radio link 136 to either confirm that the relevant configuration data had been received and assimilated, or to indicate to wireless network 140 that in fact software defined radio

apparatus had not yet received the required configuration data and was therefore not ready to take part in the above mentioned process.

In each version of the above embodiment software defined radio apparatus 130 was implemented as a mobile telephone. It is however to be appreciated that the present invention and the advantages derived therefrom apply equally to any form of software defined radio apparatus, especially mobile apparatus.

Claims

1. A method of transferring configuration data to a software defined radio apparatus; the method comprising the steps of: transmitting the configuration data to an intermediate apparatus; storing the configuration data at the intermediate apparatus; and transferring the configuration data from the intermediate apparatus to the software defined radio apparatus.

2. A method according to claim 1, wherein the configuration data is transmitted to the intermediate apparatus from a software download server.

3. A method according to claim 1 or 2, wherein the configuration data is transmitted to the intermediate apparatus at a time selected by the intermediate apparatus.

4. A method according to claim 2, wherein the configuration data is transmitted to the intermediate apparatus at a time determined by the software download server.

5. A method according to claim 1 or 2, wherein the configuration data is transmitted to the intermediate apparatus at a predetermined time or at one of a set of predetermined times.

6. A method according to any preceding claim, wherein the configuration data is transmitted to the intermediate apparatus in response to a request communicated from the software defined radio apparatus via the intermediate apparatus.

7. A method according to any of claims 1-5, wherein the configuration data is transmitted to the intermediate apparatus in response to a request communicated from the software defined radio apparatus via a radio link of the software defined radio apparatus which does not include the intermediate apparatus.

8. A method according to any preceding claim, wherein the configuration data is transmitted to the intermediate apparatus via an electrical mains connection.

9. A method according to any preceding claim, wherein the intermediate apparatus has electrical mains based battery charging means for charging a rechargeable battery of the software defined radio apparatus.

10. A method according to claim 9, wherein the configuration data is transferred from the intermediate apparatus to the software defined radio apparatus during charging of the rechargeable battery of the software defined radio apparatus.

11. A software defined radio apparatus comprising means for receiving configuration data from an intermediate apparatus.

12. An apparatus according to claim 11, further comprising means for communicating a request to the intermediate apparatus requesting the intermediate apparatus to request transmission of the configuration data to the intermediate apparatus from a software download server.

13. An apparatus according to claim 11, further comprising means for communicating a request to a software download server via a radio link of the software defined radio apparatus which does not involve the intermediate apparatus, the request being for transmission of the

configuration data to the intermediate apparatus from the software download server.

14. An apparatus according to any of claims 11-13, further comprising a rechargeable battery and means for receiving electrical charging of the battery from the intermediate apparatus.

15. An apparatus according to claim 14, further comprising means for receiving the configuration data from the intermediate apparatus whilst receiving the electrical charging from the intermediate apparatus.

16. An apparatus according to claim 15, further comprising a connector for connection to the intermediate apparatus, wherein the connector comprises one or more connection elements for the electrical charging and one or more connection elements for the configuration data.

17. An intermediate apparatus for acting as an intermediary in a process of transferring configuration data to a software defined radio apparatus; the intermediate apparatus comprising: means for receiving the configuration data; means for storing the configuration data; and means for transferring the configuration data to the software defined radio apparatus.

18. An apparatus according to claim 17, wherein the configuration data is received from a software download server.

19. An apparatus according to claim 17 or 18, further comprising means for selecting a time when the configuration data is to be received.

20. An apparatus according to claim 18, further comprising means for arranging receipt of the configuration data to take place at a time determined by the server.

21. An apparatus according to claim 17 or 18, further comprising means for arranging receipt of the configuration data to take place at a predetermined time or at one of a set of predetermined times.

22. An apparatus according to any of claims 18-21, further comprising means for forwarding to the software download server a request for the configuration data from the software defined radio apparatus.

23. An apparatus according to any of claims 17-22, wherein the means for receiving the configuration data are such as to receive the data when transmitted via an electrical mains connection.

24. An apparatus according to any of claims 17-23, further comprising electrical mains based battery charging means for charging a rechargeable battery of the software defined radio apparatus.

25. An apparatus according to claim 24, arranged such that the configuration data can be transferred to the software defined radio apparatus during charging of the rechargeable battery of the software defined radio apparatus.

26. An apparatus according to claim 25, further comprising a connector for connection to the software defined radio apparatus, wherein the connector comprises one or more connection elements for the electrical charging and one or more connection elements for the configuration data.

27. An arrangement for transferring software defined radio configuration data; the arrangement comprising an intermediate apparatus and a software defined radio apparatus; wherein the intermediate apparatus comprises means for receiving the configuration data, means for storing the configuration data, and means for transferring the configuration data to the software defined radio apparatus; and wherein the software

defined radio apparatus comprises means for receiving the configuration data from the intermediate apparatus.

28. A method, apparatus or arrangement according to any preceding claim, wherein the configuration data comprises data related to operation on one or more multiple access schemes.

29. A method, apparatus or arrangement according to claim 28, wherein the one or more multiple access schemes are selected from the group comprising: TDMA, CDMA, GSM, UMTS, AMPS, CDMA 2000, wideband-CDMA, combined TDMA/CDMA, iDEN, EDGE, IS 136, IS 95A/B, TETRA.

30. A method, apparatus or arrangement according to any preceding claim, wherein the configuration data comprises data related to operation on one or more vocoding schemes.

31. A method, apparatus or arrangement according to any preceding claim, wherein the configuration data comprises data related to operation of one or more multi-media functions.